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ABSTRACT

To determine whether high school students can be trained to use maps more effectively, a study examined linkage of feature and event information, the role of individual differences, and the roles of reading ability and preference for dealing with visual information. Subjects were 31 16- to 17-year-old high school students. Experimental and control groups each worked for three 40-minute periods on the training text (an expository passage of 1800 words) and its three maps. In the next phase subjects were given only their maps and were asked to use the maps to recall all they could about the passage. Comprehension of the training text was assessed one week after training. Three weeks after training all subjects read the transfer text with its accompanying map and were tested for comprehension. Results indicated that it was relatively easy to train students at this level of schooling to use a visual aid more effectively to enhance comprehension. Training effects were in part modified by individual differences in ability and preference, suggesting that instruction should attempt to accommodate such factors. (Three figures are included.) (SR)

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Spatial Aids and Comprehension: The Effects of Ability, Preference and Instruction

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Paper presented at the 38th Annual Meeting of the National Reading Conference, Tucson, December, 1988.

Maps are an integral part of many text-books and are often used as study devices. Recent research, however, indicates that maps act to focus readers' attention on map related information and that such focussing may prove detrimental to higher level comprehension (Abel & Kulhavy, 1986; Moore, 1988; Moore & Kirby, 1985). In addition, it appears that, at least for the most part, readers make decisions about using maps when they encounter information in the text that is related to map features (e.g. mountains, rivers) rather than when they encounter text information related to events that may have occurred at a particular feature (Moore, 1988). The use of maps in such a manner suggests that the full potential for using maps is not being realized by many readers.

The purpose of the study reported here is to see whether or not high school students can be trained to use maps more effectively by focussing upon linking feature and event information. In addition, the research examines the role that individual differences might play in interaction with such training. Of particular interest are the roles of reading ability and preference for dealing with visual information.

METHOD

Subjects and Design

A group of 16 to 17 year old high school students constituted the sample (N=31). Using stratified random sampling they were allocated to an Experimental (N=15) or Control (N=16) group. Data from 29 students were used in the analyses employing preference as two students failed to complete the questionnaire. In addition, one subject from each group was absent at the transfer test.

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The experiment was of 2 Ability (High Low) x Treatment (Experimental, Control) and 2 Visual Preference (High, Low) x Treatment (Experimental, Control) design with the dependent measures of comprehension on a training and transfer text. Median splits determined ability and preference groupings.

Materials

The training text was an expository passage of 1800 words. It was accompanied by three maps of differing size and focus. The transfer text, of 800 words was also expository and was accompanied by one map. The texts were analysed following Kirby and Cantwell (1985) for micropropositional (M1), macropropositional (M2) and thematic (M3) level information.

Ability, Preference and Comprehension Measures

Reading ability was indexed by the GAPADOL Test, Form Y (McLeod & Anderson, 1972) and visual preference was assessed using the Visual Preference Scale from the VVLS scales (Kirby, Moore & Schofield, 1988). For comprehension, free recall protocols were matched with the list of M1, M2 and M3 propositions.

In addition, test maps (for training text) and study maps (for transfer text) were examined for the inclusion of features and events in their correct geographical location. This yielded four map scores: verbal feature, verbal feature accuracy, verbal event, and verbal event accuracy.

Procedure

Experimental and control groups each worked for three 40 minute periods on the training text and its three maps. Control subjects were instructed to use the materials to write, under teacher direction, an essay about the passage. For the Experimental group, the training consisted of two phases. Phase 1 occupied the first two 40 minute periods, phase 2 the third period the following day. During phase 1 the teacher used an overhead projector to show the three maps. She modelled how important information could be placed on a map. As the text was read by the group, they summarized the information, discussed it, and then placed it onto their individual maps. The teacher also added to her map on the overhead projector in response to questioning and student input. All materials were collected at the end of the session.

In phase 2, the following day, subjects were given only their maps and were asked to use the maps to recall all they could about the passage. Utility of map usage was stressed in discussion and appropriate feedback was provided to subjects making the link between map usage and effective learning.

Subjects' comprehension of the training text was assessed one week after training. After completing the free recalls, subjects were instructed to place as much information as they could recall from the passage on their test maps.

Three weeks after training all subjects read the transfer text with its accompanying map. They were instructed to use the map to help them understand the passage. A ten minute delay occurred between reading and testing for comprehension.

RESULTS

TRAINING TEXT

Free Recalls: Ability Analyses

Separate 2 Ability (High, Low) x Treatment (Experimental, Control) x Type of Information (High, Moderate, Low on map-relatedness) repeated measures analyses of variance were conducted on the M1 and M2 scores. Only the first two factors were employed for the M3 scores.

From the M1 analyses only one effect proved to be significant, Treatment, $F(1,27) = 11.24$ (Experimental mean = 19.33, Control = 13.19). The M2 analysis revealed significant effects for Treatment, $F(1,27) = 16.71$ (Experimental mean = 3.0, Control = 1.13), Ability, $F(1,27) = 8.35$ (Experimental mean = 2.79, Control = 1.41), Treatment x Type of Information, $F(2,54) = 4.45$, Ability x Type of Information, $F(2,54) = 2.97$, and Ability x Treatment x Type of Information, $F(2,54) = 3.55$. This latter interaction is shown in Figure 1. Only one effect, Treatment, proved to be significant at the M3 level, $F(1,27) = 5.20$ (Experimental mean = 0.53, Control = 0.06).

Free Recalls: Preference Analyses

The correlation between ability and preference proved not to be significant. Separate 2 Visual Preference (High, Low) x 2 Treatment (Experimental, Control) x Type of Information (High, Moderate. Low on map-relatedness) repeated measures analyses of variance were conducted on the M1 and M2 scores. Only the first two factors were entered into the M3 analyses.

There was only one significant effect involving visual preference. This was a Preference x Treatment x Type of Information interaction for M2 scores, $F(2, 50) = 3.97$, shown in Figure 2.

Map Completion Task (Test Maps)

2 Ability (High, Low) x 2 Treatment (Experimental, Control) and 2 Visual Preference (High, Low) x Treatment

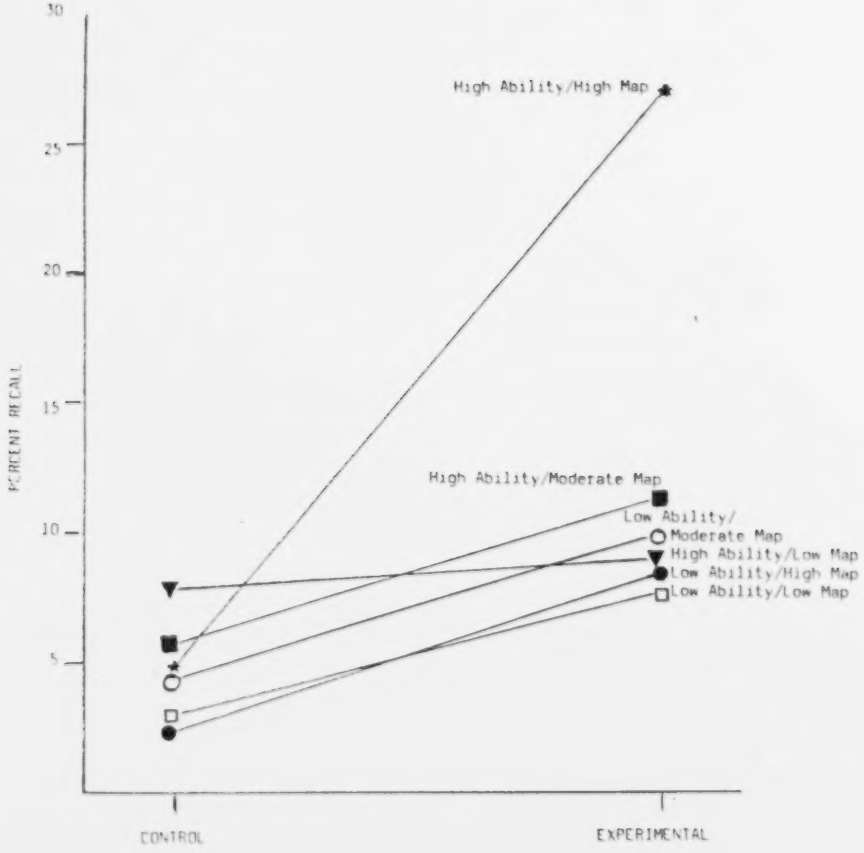

Figure 1: Treatment x Ability x Type Interaction
for M2 Propositions (Training)

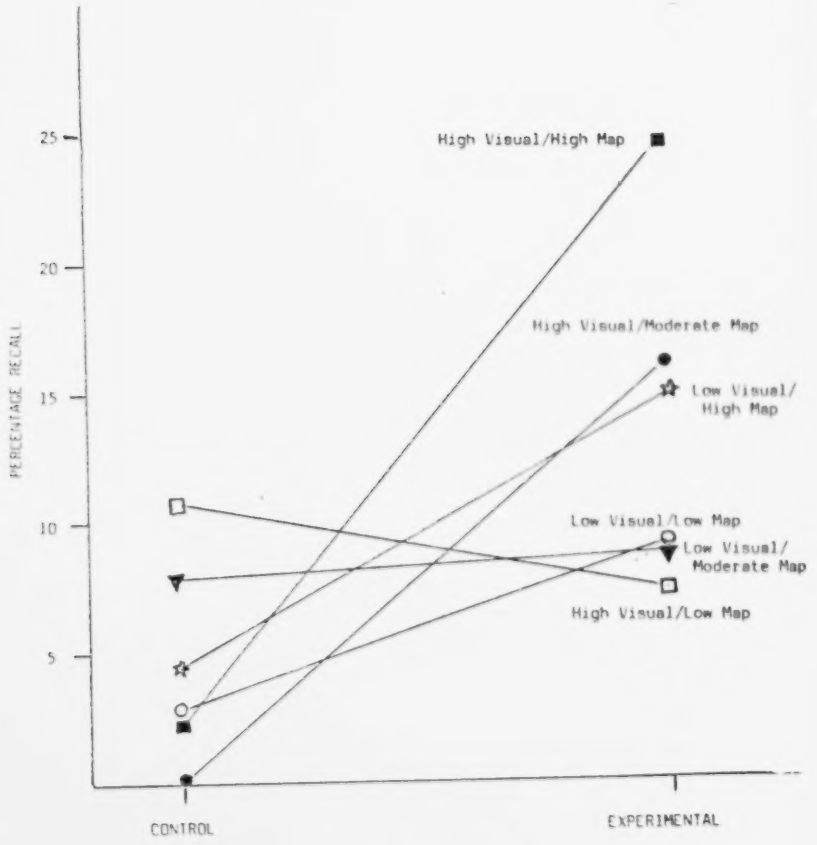

Figure 2: Treatment x Preference x Type Interaction
for M2 Propositions (Training)

(Experimental, Control) analyses of variance were conducted on the test map scores. No significant effects were revealed in the analyses of feature information. For event information, Experimental subjects were shown to incorporate significantly more event information, $F(1,27) = 100.85$ (Experimental mean = 12.33, Control = 0.63) and place that information in the appropriate location on the map, $F(1,27) = 61.90$ (Experimental mean = 7.80, Control = 0.69). No significant interactions emerged.

TRANSFER TEXT

Free Recalls

For the transfer text, two measures were analysed, free recalls and the inclusion of information on the study map. The free recalls were analysed as for the training text. At the M1 level the significant effects were Ability, $F(1,25) = 20.86$, Treatment x Ability, $F(1,25) = 4.28$, and Ability x Treatment x Type of Information, $F(2,50) = 3.05$ shown in Figure 3.

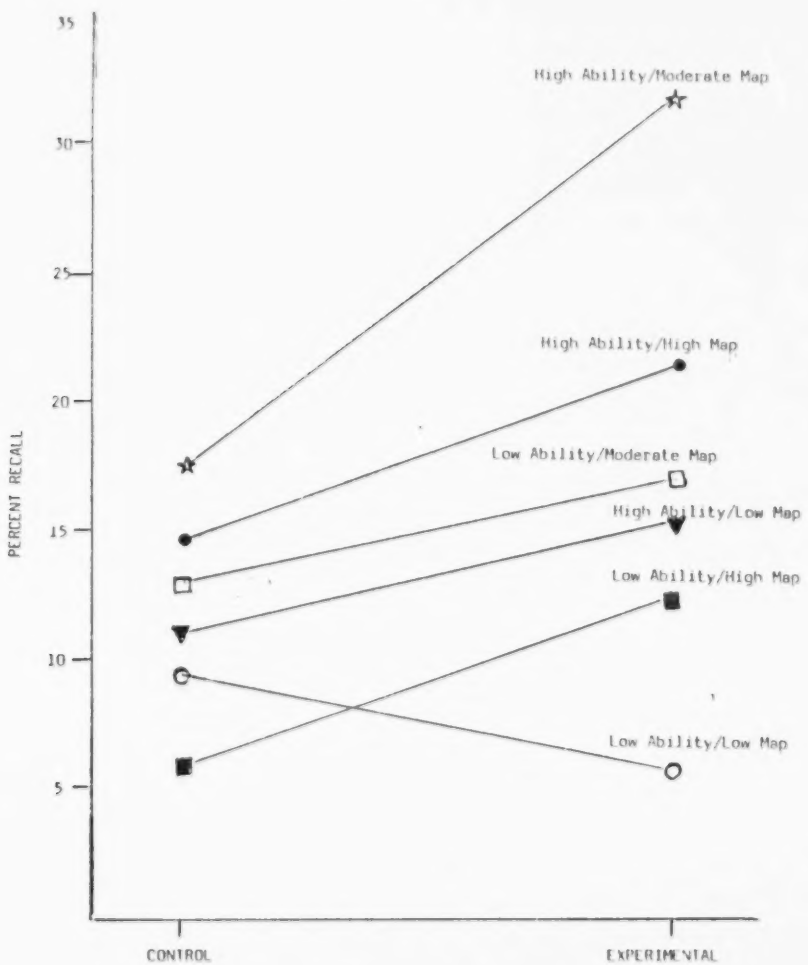

Figure 3: Treatment x Ability x Type Interaction for M1 Propositions (Transfer)

At the M2 level the effects were Ability, $F(1,25) = 16.35$ (High mean = 3.36, Low = 1.93) and Treatment, $F(1,25) = 4.88$ (Experimental mean = 2.86, Control = 1.60). The M3 analyses showed no significant effects.

Study Maps

An examination of the maps used during reading of the transfer text showed that not one of the Control subjects had added information to the map. On the other hand, 11 of the 14 Experimental subjects added verbal event information to their maps (mean = 11.50) and were reasonably successful in correctly locating that information (mean = 8.30). Seventy three percent of the subjects who added to their maps were classified as high on the Visual Preference scale.

Correlations computed between the verbal event accuracy scores and free recall scores revealed consistent positive relationships between verbal event accuracy scores and recall of high, moderate and low map-related M1 information (0.54, 0.30, 0.56). At the M2 level the respective correlations were -0.12, 0.33, and 0.59. No significant correlations were found between map scores and recall of M3 level information.

SUMMARY OF FINDINGS

For Training Text

1. Subjects receiving training in map usage proved to be significantly superior to controls on recall of M1, M2 and M3 level information.

2. In contrast to previous research (non-training), this superiority was not attributable to a focus of attention on high map-related information.

3. High ability students benefitted most from training especially in recall of high map-related M2 level information.

4. Visual preference only played a significant role in recall of M2 level information. High visualizers in the trained group benefitted most from training at the M2 level.

5. In the placement of information on the test map, trained subjects were significantly superior to controls in event-related scores but there were no differences in feature scores.

For Transfer Text

1. Subjects receiving training were significantly superior to controls on recall of M2 level information.

2. High ability students benefitted most from training at the M1 level.

3. Only trained students added to their study maps while reading the transfer text. Students who added information were predominantly high visualizers.

CONCLUDING COMMENTS

The results reported above indicate that it is relatively easy (at least in terms of time, resources and effort by the teacher) to train students at this level of schooling to use a visual aid more effectively to enhance comprehension. It seems that it is not a matter of whether a map is used but rather how it is used.

That the training effects were in part modified by individual differences in ability and preference suggests that instruction should attempt to accommodate such factors if maximum benefit is to be obtained.

ACKNOWLEDGEMENTS

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